AMENDMENTS TO THE CLAIMS

1. (Presently Amended) An apparatus for electrical detection of molecular interactions between immobilized probe molecules and target molecules in a sample solution, comprising:

~~(a)~~ a supporting substrate comprising an array of test sites,

~~(b) a plurality of porous, polymeric pads in contact with the supporting substrate at the test sites,~~

~~(c)~~ a set of input electrodes, each in contact with ~~the plurality of porous, polymeric pads at the~~ a plurality of test sites, ~~wherein each input electrode is arranged such that a first portion of the input electrode is in contact with a test site and a second portion of the input electrode is in contact with a different test site,~~

a multiplexor connected to the set of input electrodes;

~~(d)~~ a set of output electrodes, each in contact with ~~the plurality of porous, polymeric pads at the~~ a plurality of test sites, ~~wherein each output electrode is arranged such that a first portion of the output electrode is in contact with a test site and a second portion of the output electrode is in contact with a different test site, and wherein each output electrode is in electrochemical contact with an input electrode,~~;

a demultiplexer connected to the set of output electrodes;

~~(e)~~ a conjugated polymer ~~plurality of linker moieties~~ in contact with the ~~porous, polymeric pads at the~~ test sites, and

~~(f)~~ a plurality of probe molecules immobilized to the ~~linker moieties~~conjugated polymer, wherein said probe molecules specifically bind to or interact with target molecules,

~~(g) a signal generator for producing an electrical signal at each input electrode,~~

~~(h) a detector for detecting changes in the electrical signal at each output electrode, and~~

~~(i) an electrolyte solution in contact with the porous polymeric pads, input electrodes, output electrodes, linker moieties, and probe molecules, wherein molecular interactions between the immobilized probe molecules and target molecules are detected as a difference in the electrical signal detected at each output electrode in the presence and absence of target molecules.~~

2. (Presently Amended) An apparatus for electrical or electrochemical detection of molecular interactions between immobilized probe molecules and target molecules in a sample solution, comprising:

~~(a)~~ a supporting substrate comprising an array of test sites,

~~(b) a plurality of porous, polymeric pads in contact with the supporting substrate at the test sites,~~

~~(c)~~ a set of input electrodes, each in contact with ~~the plurality of porous, polymeric pads at the~~ a plurality of test sites, ~~wherein each input electrode is arranged such that a first portion of the input~~

~~electrode is in contact with a test site and a second portion of the input electrode is in contact with a different test site,~~;

a multiplexor connected to the set of input electrodes

~~(d)~~ a set of output electrodes, each in contact with ~~the plurality of porous, polymeric pads at the~~ a plurality of test sites~~, wherein each output electrode is arranged such that a first portion of the output electrode is in contact with a test site and a second portion of the output electrode is in contact with a different test site, and wherein each output electrode is in electrochemical contact with an input electrode,~~ ;

a demultiplexor connected to the set of output electrodes;

~~(e)~~ a ~~plurality of linker moieties~~ conjugated polymer in contact with the ~~porous, polymeric pads at the~~ test ~~sites~~;~~,~~

~~(f)~~ a plurality of probe molecules immobilized to the ~~linker moieties~~conjugated polymer, wherein said probe molecules specifically bind to or interact with target molecules; and~~,~~

~~(g)~~ at least one reference electrode in electrochemical contact with the input and output electrodes~~.,~~

~~(h) a signal generator for producing an electrical signal at each input electrode,~~

~~(i) a detector for detecting changes in the electrical signal at each output electrode, and~~

~~(j) an electrolyte solution in contact with the porous polymeric pads, input electrodes, output electrodes, linker moieties, reference electrode, and probe molecules, wherein molecular interactions between the immobilized probe molecules and target molecules are detected as a difference in the electrical signal detected at each output electrode in the presence and absence of target molecules.~~

3. (Previously Amended) An apparatus according to claim 1, wherein the output electrodes and input electrodes are interdigitated at the test site.

4. (Previously Amended) An apparatus according to claim 2, wherein the output electrodes and input electrodes are interdigitated at the test site.

5. (Original) The apparatus of any of Claims 1, 2, 3, or 4, wherein the supporting substrate comprises ceramic, glass, silicon, silicon nitride, fabric, rubber, plastic, printed circuit board, compound semiconductors, or combination thereof.

Claims 6-7. (Cancelled)

8. (Original) The apparatus of any of Claims 1, 2, 3, or 4, wherein the input electrodes comprise solid or porous gold, silver, platinum, copper, titanium, chromium, or aluminum, or metal oxide,

metal nitride, metal carbide, carbon, graphite, conductive plastic, metal impregnated polymers, or combinations thereof.

9. (Original) The apparatus of Claim 8, wherein the input electrodes comprise platinum.

10. (Original) The apparatus of Claim 8, wherein the input electrodes comprise gold.

11. (Original) The apparatus of any of Claims 1, 2, 3, or 4, wherein the input electrodes comprise a conductive material and an insulating material.

12. (Original) The apparatus of Claim 11, wherein the conductive material is solid or porous gold, silver, platinum, copper, titanium, chromium, or aluminum, or metal oxide, metal nitride, metal carbide, carbon, graphite, conductive plastic, metal impregnated polymers, or combinations thereof.

13. (Original) The apparatus of Claim 12, wherein the conductive material is platinum.

14. (Original) The apparatus of Claim 12, wherein the conductive material is gold.

15. (Original) The apparatus of Claim 11, wherein the insulating material is glass, silicon, plastic, rubber, fabric, ceramic, printed circuit board, or combinations thereof.

16. (Original) The apparatus of Claim 15, wherein the insulating material is silicon.

17. (Original) The apparatus of Claim 15, wherein the insulating material is glass.

18. (Original) The apparatus of Claim 11, wherein the conductive material is embedded in the supporting substrate and the supporting substrate comprises the insulating material.

19. (Cancelled)

20. (Original) The apparatus of any of Claims 1, 2, 3, or 4, wherein the output electrodes comprises solid or porous gold, silver, platinum, copper, titanium, chromium, or aluminum, or metal oxide, metal nitride, metal carbide, carbon, graphite, conductive plastic, metal impregnated polymers, or combinations thereof.

21. (Original) The apparatus of Claim 20, wherein the output electrode comprises platinum.

22. (Original) The apparatus of Claim 20, wherein the output electrode comprises gold.

23. (Original) The apparatus of any of Claims 1, 2, 3, or 4, wherein the output electrode comprises a conductive material and an insulating material.

24. (Original) The apparatus of Claim 23, wherein the conductive material is solid or porous gold, silver, platinum, copper, titanium, chromium, or aluminum, or metal oxide, metal nitride, metal carbide, carbon, graphite, conductive plastic, metal impregnated polymers, or combinations thereof.

25. (Original) The apparatus of Claim 24, wherein the conductive material is platinum.

26. (Original) The apparatus of Claim 24, wherein the conductive material is gold.

27. (Original) The apparatus of Claim 23, wherein the insulating matetial is glass, silicon, plastic, rubber, fabric, ceramic, printed circuit board, or combinations thereof.

28. (Original) The apparatus of Claim 27, wherein the insulating material is silicon.

29. (Original) The apparatus of Claim 27, wherein the insulating material is glass.

30. (Original) The apparatus of Claim 23, wherein the conductive material is embedded in the supporting substrate and the supporting substrate comprises the insulating material.

Claims 31-33. (Cancelled)

34. (Presently Amended) The apparatus of Claims 1, 2, 3, or ~~4~~33, wherein the conjugated polymer ~~or copolymer is~~ comprises a neutral pyrrole matrix, polypyrrole, polythiphene, polyaniline, polyfuran, polypyridine, polycarbazole, polyphenylene, poly(phenylenvinylene), polyfluorene, or polyindole, or their derivatives, or copolymers~~, or combinations thereof~~.

35. (Cancelled).

36. (Cancelled)

37. (Original) The apparatus of any of Claims 1, 2, 3, or 4, wherein the probe molecules are oligonucleotides or nucleic acids.

38. (Original) The apparatus of Claim 37, wherein the probe molecules are aptamers.

39. (Original) The apparatus of any of Claims 1, 2, 3, or 4, wherein the probe molecules are proteins or peptides.

40. (Original) The apparatus of Claim 39, wherein the peptides are antibodies.

41. (Original) The apparatus of Claim 40, wherem the antibodies are a polyclonal antisera, polyclonal antibodies, or F(ab), F(ab)', F(ab)2,or Fv fragments thereof.

42. (Original) The apparatus of Claim 40, wherein the antibodies are monoclonal antibodies, or F(ab), F(ab)', F(ab)2,or Fv fragments thereof.

43. (Original) The apparatus of Claim 40, wherein the antibodies are F(ab) fragments or single chain Fv fragments produced by in vitro libraries.

44. (Presently Amended) The apparatus of any of Claims 1, 2, 3, or 4, wherein the probe molecules comprise probe molecules selected from a natural products library, a phage display library, or a combinatorial library.

45-48. (Cancelled)

49. (Original) The apparatus of either Claims 2 or 4, wherein the reference electrode comprises solid or porous gold, silver, platinum, copper, titanium, chromium, or aluminum, or metal oxide, metal nitride, metal carbide, carbon, graphite, conductive plastic, metal impregnated polymers, or combinations thereof.

50. (Original) The apparatus of Claim 49, wherein the reference electrode comprises platinum.

51. (Original) The apparatus of Claim 49, wherein the reference electrode comprises gold.

52. (Original) The apparatus of either Claims 2 or 4, wherein the conductive material is silver/silver chloride.

53. (Original) The apparatus of either Claims 2 or 4, wherein the reference electrode comprises a conductive material and an insulating material.

54. (Original) The apparatus of Claim 53, wherein the conductive material is solid or porous gold, silver, platinum, copper, titanium, chromium, or aluminum, or metal oxide, metal nitride, metal carbide, carbon, graphite, conductive plastic, metal impregnated polymers, or combinations thereof.

55. (Original) The apparatus of Claim 54, wherein the conductive material is platinum.

56. (Original) The apparatus of Claim 54, wherein the conductive material is gold.

57. (Original) The apparatus of Claim 53, wherein the insulating material is glass, silicon, plastic, rubber, fabric, ceramic, printed circuit board, or combinations thereof.

58. (Original) The apparatus of Claim 57, wherein the insulating material is silicon.

59. (Original) The apparatus of Claim 57, wherein the insulating material is glass.

60. (Original) The apparatus of Claim 53, wherein the conductive material is embedded in the supporting substrate and the supporting substrate comprises the insulating material.

61. (Presently Amended) The apparatus of any of Claims 1, 2, 3, or 4, wherein the supporting substrate further comprises a plurality of wells ~~wherein each well encompasses a porous, polymeric pad, wherein a plurality of probe molecules is immobilized to linker moieties that are in contact with the porous, polymeric pad; an input electrode; and an output electrode~~.

62-63. (Cancelled)

64. (Previously Amended) A method for the electrical detection of molecular interactions between a probe molecule immobilized at a specific test site and a target molecule in a sample solution, comprising:

selecting a first input electrode in contact with a plurality of test sites including said specific test site;

~~(a)~~ applying an ~~first~~ electrical input signal ~~at an~~ to said selected input electrode ~~in contact with a first set of porous, polymeric pads, wherein the first set of porous, polymeric pads comprises~~ the porous, polymeric pad at the specific test site,;

selecting a first output electrode in contact with a plurality of test sites including said specific test site;

~~(b) detecting the first electrical~~ an output electrical signal at ~~an~~ said selected output electrode ~~in contact with a second set of porous, polymeric pads, wherein the second set of porous, polymeric pads comprises the porous, polymeric pad at the specific test site,~~;

~~(c) exposing the first and second sets of porous, polymeric pads~~ specific test site to a sample mixture containing the target molecule to form a conjugated complex, wherein said conjugated complex does not comprise a reporter group; and~~,~~

detecting said target molecule based, at least in part, on said output electrical signal.

~~(d) applying a second electrical signal at an input electrode in contact with the first set of porous, polymeric pads,~~

~~(e) detecting the second electrical signal at an output electrode in contact with the second set of porous, polymeric pads,~~

~~(f) comparing the first electrical signal detected in step (b) with the second electrical signal detected in step (e), and~~

~~(g) determining whether the first electrical signal is different from the second electrical signal.~~

65. (Previously Amended) The method of Claim 64, wherein molecular interactions between probe molecules and target molecules are detected by using an electrical or electrochemical detection method selected from the group consisting of impedance spectroscopy, cyclic voltammetry, alternating current (AC) voltammetry, pulse voltammetry, square wave voltammetry, hydrodynamic modulation voltammetry, conductance, potential step method, potentiometric measurements, amperometric measurements, and current step method.

66. (Previously Amended) The method of Claim 64, wherein molecular interactions between probe molecules and target molecules are detected by using an electrical or electrochemical detection method that is alternating current (AC) impedance and the AC impedance is measured over a range of frequencies.

67. (Previously Amended) The method of Claim 64, wherein molecular interactions between probe molecules and target molecules are detected by using an electrical or electrochemical detection method that is alternating current (AC) impedance and the AC impedance is measured by transient methods with AC signal perturbation superimposed upon a direct current (DC) potential applied to an electrochemical cell.

68. (Previously Amended) The method of Claim 64, wherein molecular interactions between probe molecules and target molecules are detected by using an electrical or electrochemical detection method that is alternating current (AC) impedance and the AC impedance is measured by impedance analyzer, lockin amplifier, AC bridge, AC voltammetry, or combinations thereof.

69-73. (Cancelled)

74. (Presently Amended) The method of Claim 64, wherein the ~~first~~ input ~~and second~~ electrical signal~~s~~ ~~are~~ is applied using a multiplexer.

75. (Presently Amended) The method of Claim 64, wherein the ~~first and second electrical~~output electrical signal~~s~~ ~~are~~ is detected using a demultiplexer.

76 – 80. (Cancelled)